CHAPTER 5
DISCUSSION
The present study was undertaken to evaluate the seroprevalence of human toxocariasis, identify its risk factors, to determine its relationship with the health status of infected persons and also to know the prevalence of *Toxocara canis* in stray dog population of Kashmir valley. The individuals screened for *Toxocara* infection were recruited randomly from both male and female individuals of all the age groups. Factors that were significantly correlated with human toxocariasis were age, gender, house fenced, pet in house, contact with dogs, eating habits, geophagia, source of drinking water, condition of water and parental education. Analysis of the seropositive and seronegative individuals for blood biochemical and haematological parameters was done to assess any correlations.
5.1. *Toxocara* seroprevalence in general human population

The present study revealed a total seroprevalence of 36.38% for *Toxocara* in human population. The prevalence is nearly same as has been reported earlier from different parts of the world e.g. Santos *et al.* (2004) reported a prevalence of 39.4% in children and adult population in Brazil. Ajayi *et al.* (2000) reported a frequency of 29.6% of human toxocariasis in Nigeria. Sadjjadi *et al.* (2000) reported a seroprevalence of 25.6% in school children in Iran. Alderete *et al.* (2003) reported a seroprevalence of 38.8% among children. Deutz *et al.* (2005) reported a total of 25.8% of *Toxocara* infestations in Austria. Fan *et al.* (2004b) reported a seroprevalence of 46% in aboriginal population and 30.2% in Ethenic Han population. Alonso *et al.* (2000) reported 37.9% of *Toxocara* seroprevalence in children.

Variations have been observed in *Toxocara* seroprevalence by serological studies in different parts of the world, ranging from 6.4% to 86% (Malla *et al.* 2002; Thompson *et al.* 1986). These variations in seroprevalence rates may be due to variation in the environmental factors like humidity and temperature which determine the survival of the *Toxocara* eggs in the particular environment for a specific period of time. Variations observed in different parts of the world may also be due to different life styles like presence of pet in the house, eating habits, occupation, personal hygiene etc.
5.2. Risk factors for human Toxocariasis

Factors like age, gender, pet in house, contact with dogs, eating habits, house fencing, source and condition of drinking water were found significantly associated with *Toxocara* infection.

5.2.1. Age wise distribution

In the present study *Toxocara* seroprevalence rate was found to be high in the adults than in children. These results are supported by Fan *et al.* (2004b) who observed that seroprevalence tended to increase with age. It was 31.8% for people in 20’s, fluctuated between 43.9% to 47.5% in those 30-59 years and reached as high as 51.5% in greater than 60 years of age. Deutz *et al.* (2005) and Ajayi *et al.* (2000) also confirmed the similar results in their observations. Logar *et al.* (2004) also found the higher rate of *Toxocara* infection in patients >14 years of age groups than lower age groups. Thus it can be concluded from the present study that seroprevalence of *Toxocara* infection increases with age. The higher seroprevalence of *Toxocara* in older age groups was due to their longer exposure to various risk factors related to the infection with *Toxocara canis* and due to persistence of antibody titres for a longer period of time.

5.2.2. Residence

Individuals from all the districts had almost similar rate of seroprevalence, except district Srinagar, where seroprevalence of *Toxocara* was comparatively low. In children population, it was 25% and in adults it was 36.84%, which in comparison to other districts is less. The reason for
this difference is the presence of more civic facilities in Srinagar so; there is less chance of getting infection. Another reason is the role of veterinary department. Due to sterilisation programme launched in Srinagar city during 2004, large number of dog population was sterilised by the veterinary unit of Srinagar municipal department, thus decreasing the number of dogs in Srinagar district. With the result, environment of Srinagar district has become less contaminated by *Toxocara* eggs. Srinagar municipal department is also having a role in safe disposal of waste substances and faecal matter of dogs from the district. Another important factor responsible for less *Toxocara* seroprevalence in Srinagar district is the education regarding the personal hygiene and infectious diseases. So the people of district Srinagar are less susceptible to *Toxocara* infection. Our findings are supported by Alderete *et al.* (2003), who found that children from low family incomes and poorest socioeconomic conditions were more *Toxocara* seroprevalent as compared to others.

5.2.3. Gender

The present study revealed a higher seroprevalence of *Toxocara* infection in males relative to females. In this the results are in agreement with different studies conducted in other parts of the world. Kanafani *et al.* (2005) showed gender having statistically significant difference in *Toxocara* seroprevalence. Havasiova *et al.* (1993) also showed male individuals having more seroprevalence of *Toxocara* infection than females, but the results were contrasting in adults. Overgaauw (1997) found a
predominance of Toxocara infection in males. Glickman and Schantz (1981) reported a higher seroprevalence in males than females in terms of Toxocara seroprevalence in gender analysis. Abo-shehda et al. (1992) studied a group of children and young adults from Jordan and reported significant differences in seroprevalence between sexes which however had age correlation. The authors suggested that difference in social behaviour and the fact that outdoor activities were restricted in girls in Jordan aged beyond 14 yrs, might explain time of the observed sex related differences and their correlation with age. Our observations are also in agreement with other studies as Deutz et al. (2005), Matos et al. (1997) and Marmor et al. (1987). The difference in the prevalence rates between the genders is due to the difference in the gender behaviour. In our society due to some social and religious restrictions, females are relatively confined to indoors whereas males predominantly have to work in outdoor environment. Being mostly indoor, females are relatively less exposed to the contaminated environments and have thus lesser chances of getting infection than males. Thus concluding from the present study and above discussion that male population was more susceptible to Toxocara infection and gender acts as an important risk factor.

5.2.4. Pet in house

Contact with dogs or presence of pet in house determines the high risk for Toxocara prevalence and was found significant factor for toxocariasis (P<0.05). In the present study significant association was found between presence of dogs in houses or in neighbourhood and prevalence of toxocariasis in
humans. The infection is probably acquired inadvertently by ingesting eggs contaminating dog’s body or their high abundance in the surrounding environment. A recent study indicated that dogs infected with *Toxocara canis* might infect people by direct contact because of the high density of embryonated and unembryonated eggs in their fur (Wolfe and Wright, 2003). A higher frequency of infection in individuals who maintained contact with dogs has been reported by Fan *et al.* (2004b, 2005); Figueiredo *et al.* (2005); Sadjjadi *et al.* (2000); and Malla *et al.* (2002). The presence of dogs either in home or in neighbourhood seems to be an important risk factor for *Toxocara* infection.

5.2.5. Eating habits

Individuals having a habit of eating raw vegetables were also considered as having a habit of pica, because raw vegetable eating persons get some amount of soil ingestion by eating these vegetables either uncooked or unwashed. As vegetables are cultivated in the fields where we most often find stray dogs moving freely and defecating. So there are the chances of getting the *Toxocara* eggs on the vegetables. During this study, the persons having the habit of eating raw vegetables or having a habit of geophagia were found having high seroprevalence of *Toxocara* infection. The difference in the seroprevalence relative to those who did not eat raw vegetables was statistically significant. The results are in agreement with other studies. Fan *et al.* (2004a) observed that toxocaral infection in Taiwanese aboriginal children area was acquired by the ingestion of soil
containing infective eggs. Hayashi _et al._ (2005) found that the difference of _Toxocara_ seroprevalence between urban and rural children population may be attributed to differences in their behaviour and in the management of wastes between urban and rural areas. The rural children while eating may ingest some amount of contaminated soil thus are more susceptible to infections of toxocariasis than urban children. Glickman _et al._ (1981) reported significant association between pica patterns and evidence of subclinical infection with _Toxocara_. Holland _et al._ (1995) found a significant association between _Toxocara_ seropositivity in children and a history of geophagia. Berrocal (1980) reported that 75% of the infants of the study populations had a positive serology for _Toxocara_ and pica was found significantly related to prevalence of the disease. Alonso _et al._ (2000) observed a significant association between onychophagy and positive serology. Thus it is concluded that the eating habits is one of the important risk factors of _Toxocara_ infection and should therefore be considered.

5.2.6. **Source of drinking water**

Source of water is regarded as a more probable risk for various types of helminth infections. In the present study, it was found that water source was an important factor causing _Toxocara_ infection in humans. Dogs defecating in open fields and on the banks of rivers, streams and ponds deposit large number of _Toxocara_ eggs. During rainy season, these eggs flow into the water bodies thus making the water contaminated. The different sources of water are thus continuously getting contaminated by
the Toxocara eggs. People using water from these contaminated sources are more likely to get infected. In the current study the prevalence of Toxocara infection was more in people using water from streams, rivers, ponds and wells than those using water from public piped water supply and the difference was found statistically significant. Similar results were found by Hayashi et al. (2005), who observed that those areas using water sources from wells were having more seroprevalence of Toxocara infection compared to the areas where public water supply system was available. Thus from the present study it is concluded that the source of drinking water was an important factor in the prevalence of Toxocara infection in humans. So attention should be given towards the water resources used for various purposes like drinking and washing.

5.2.7. Personal hygiene

People working in open fields have more chances of getting infection due to the unhygienic conditions. Working in open fields means direct contact with the soil, contaminated by the Toxocara eggs. The defecation of stray dogs in open fields makes the open fields fully lodged with Toxocara eggs. Also individuals working in open fields sometimes drink water from streams or from other open water bodies making them susceptible to Toxocara infection. In numerous studies done in different parts of world, it has been observed that in the persons working in open fields, seroprevalence of Toxocara infection was more and the contribution was statistically significant (Kimming et al., 1991). Deutz et al. (2005) obtained a
statistically significant correlation between the exposure factor, occupation and the *Toxocara* antibody response. Compared to the control group, all other occupational groups showed a much higher risk of infection. Fan *et al.* (2004b), Sturchelir and Peter (1981) also found occupation and lack of education as important factors for *Toxocara* seroprevalence. Adults who worked as laborers seemed to have greater risk for exposure to infection with *Toxocara canis*. The risk of infection was related to the intensity and duration of exposure of the people. Thus from the present study it was concluded that lack of education about personal hygiene was an important factor contributing to the seroprevalence of toxocariasis in humans.

5.2.8. Parental education

Children whose parents were educated were less prone to infection than those whose parents were illiterate, and in particular mother’s education had a major role. Similar results were also found by Worley *et al.* (1984), who detected higher antibody titres in children whose parents were having low level of education. Similarly Figueiredo *et al.* (2005) reported higher level of infection in children whose mother’s had low educational levels. So from the current study it was concluded that parental education plays an important role in determining the prevalence of *Toxocara* infection.

5.2.9. House fencing

Whether the house is fenced or not had a great impact on *Toxocara* prevalence. The outer fencing of the house contributes towards susceptibility of *Toxocara* seroprevalence in humans. In the present study it
was observed that individuals whose houses were fenced were less likely to be infected with *Toxocara* relative to those whose houses were not fenced. This may be due to the easy access of stray dogs to unfenced houses and contamination of house yards by the faecal matter of dogs. Abe and Yasukawa (1996) conducted a study on the effect of fence on the contamination of parks in Osaka city. Fence construction around the parks decreased the number of eggs recovered from the sand pits in these fenced parks. Isomursu Marja and Oksanen Antti found that play grounds in Oulu; Finland had zero prevalence of *Toxocara canis* which was due to less number of stray puppies and proper maintenance of play grounds. Hence it is concluded that fence construction around playgrounds or houses restricts the movement of stray dogs within these areas and has consequent effects on the prevalence of *Toxocara* infection.

5.3. Haematological and blood biochemical investigation.

These parameters are discussed separately as under:

5.3.1. Haematological investigation

5.3.1.1. Haemaglobin

In the present study, *Toxocara* infection and haemoglobin (Hb) value was correlated and it was observed that infected individuals had lower mean Hb values as compared to uninfected. The reasons for this difference are many. Due to poverty, people are already at the risk of having low Hb value and when infected by *Toxocara* infection, conditions
get aggravated. Present results are supported by many other studies e.g. Rayes et al. (2001) found Hb value of < 12.5 g/dl in 88% of the toxocariasis patients. Sharma et al. (1984) while conducting experimental work on chickens infected with Toxocara canis found a significant decrease in haemoglobin. Thakur et al. (1998); Baldisserotto et al. (1999) found haemoglobin level below the normal values in case of toxocariasis patients. Arango et al. (1998) in visceral larva migrans case found Hb value was low. Similarly in other studies like Singh et al. (1992) and Alonso et al. (2000) found haemoglobin level falls below the normal value in toxocariasis patients. From the above discussion it is clear that toxocariasis is associated with a condition leading to anaemia.

5.3.1.2. Total leucocyte count

Leukocytes play important role against various types of infectious diseases to lessen their effect on human body. During any type of infection in human body, the leukocytes increase in number, so as to quickly fight against the infecting pathogenic organisms. In the present study, it was found that Toxocara infected individuals were having high number of leukocytes compared to uninfected individuals. Arango (1998) reported visceral larva migrans displaying a white blood cell count of 42,000 cells per mm³. The other studies that are in agreement with the present study include Baldisserotto et al. (1999); Singh et al. (1992); Ashwath et al. (2004); Vidal et al. (2003); Xinou et al. (2003); Sommerfelt et al. (2006) and Sharma et al. (1984). Yarson et al. (2003) while conducting an experimental work on
mice infected with *Toxocara* found significant increases in leukocytes occurred only after 8 days of *Toxocara* infection.

5.3.1.3. Eosinophils

The eosinophil was first recognized 126 years ago as a distinct cellular element through the pioneering work of Paul Erlich. They are primarily a tissue cell, with only 1-2% of them found in the circulation. Normal functions of eosinophil resemble to those of other circulatory phagocytes: chemotaxis, chemokinesis, phagocytosis, cytotoxicity, antiparasitic activity, bactericidal activity, effector of immediate hypersensitivity modulation of inflammatory response, besides releasing toxic substances against multi variety parasites. It has been seen that their number increases in case of nematode infections.

In the present study eosinophils were found raised in all the individuals who were *Toxocara* seropositive and the difference was found significant. These results are supported by other observations e.g. Sommerfelt *et al.* (2001) in an experimental work found that eosinophils were significantly higher in pigs inoculated with *Toxocara* eggs compared to control groups. Figueiredo *et al.* (2005) observed extremely significant association between seropositivity and eosinophilia. Tonz *et al.* (1983) found eosinophilia as an excessive and sustained symptom in 6 clinical observations. Giacometti *et al.* (2001) found all *Toxocara* seropositive individuals, with the exception of the subject in the control group, showed an increase above normal in the number of eosinophils per unit volume of
peripheral blood. Alonso et al. (2000) found very high values of total eosinophilia in *Toxocara* seropositive children. Marmor et al. (1987) found that all cases of *Toxocara* infection had higher mean percentages of eosinophils than controls (2.6±4.3 percent in cases versus 1.3 percent ±2.8 percent cells/mm³) in controls; mean difference = 1.3 percent and higher absolute number of eosinophils (211±36.2 cells/mm³ in cases versus 121±290 cells/mm³ in controls; mean difference = 90 cells /mm³). Havasiova et al. (1993) found that clinical manifestations of the *Toxocara* in the studied groups of patients were highly variable. The most frequent were leukocytosis and eosinophilia (46%). Berrocal (1980) reported in many cases of toxocariasis that eosinophilia was predominantly high and acted as a diagnostic feature in these cases. Hayashi et al. (2005) reported that 24 of the 34 subjects (70.6%) had hypereosinophilia with five of these showing extreme hypereosinophilia. Santos et al. (2004) found that individuals with higher eosinophil counts presented a greater frequency of anti-*Toxocara* antibodies and the relation between the eosinophilia and *Toxocara* infection was found statistically significant. Sommerfelt et al. (2001) reported a significant relation between eosinophil count and groups inoculated by *Toxocara canis* as compared to control. Various other studies that report a correlation between eosinophil count and *Toxocara* infection include Ashwath et al. (2004); Arango (1998); Yarson et al. (2003), Xinou et al. (2003); Vidal et al. (2003); Sharma et al. (1984); Sugane et al. (1984); Inan et al. (2006); Alonso et al. (2000); Yokoi et al. (2003); Shimizu et al. (2005); Kwon et al. (2006); Thakur et al. (1998); Savigny et al. (1979); Singh et al. (1992).
Baldisserotto et al. (1999); Azuma et al. (2002); Demirci et al. (2002); Silva et al. (2004) and Taranto et al. (2003). Thus from the present study and above discussion it was concluded that while going for the Toxocara serological examination in humans, patients should be advised for the eosinophil count so as to get the proper diagnosis of the disease easier.

5.3.1.4. Total Erythrocyte count

In present study, effect of Toxocara infection on the total erythrocyte count showed no significant difference between infected and uninfected individuals. Similar results have been reported by other workers Sommerfelt et al. (2001) in Toxocara canis infected pigs found no significant changes in R.B.C. count. Similarly various other studies supporting the present observation include Xinou et al. (2003); Fan et al. (2006); Inan et al. (2006); Ashwath et al. (2004) and Alonso et al. (2000). So, it was concluded that in case of Toxocara infection in humans there was no effect on R.B.C. count.

5.3.2. Blood biochemical investigation

In the current study, various blood biochemical parameters were studied to know the effect of Toxocara infection. Most of the blood biochemical parameters were found unaffected by the Toxocara infection except alkaline phosphatase which was significantly raised. The serum creatinine levels were found to be in normal range in Toxocara infected individuals. Similar results have been reported by Singh et al. (1992), who
observed the level of serum creatinine in normal range in case of visceral larval migrans. The other studies that are in agreement with the present study are Thakur et al. (2006); Inan et al. (2006); Eberhard and Alfano (1998); Vidal et al. (2003) and Xinou et al. (2003). Thus it was concluded that serum creatinine was not one of the Toxocara infection determining factors.

The Toxocara infection had not any effect on blood glucose level and there was no significant difference between the infected and uninfected persons. This observation is supported by other studies. Vidal et al. (2003) and Xinou et al. (2003) found no change in blood glucose level in Toxocara disease infected cases. Inan et al. (2006), and Singh et al. (1992) observed that the level of blood glucose were in normal range in adult visceral larva migrans. The other studies which are in agreement with the present work include Sommerfelt et al. (2006); Sommerfelt et al. (2001); Thakur et al. (1998) and Silva et al. (2004). So from the above discussion it is concluded that there is no effect of Toxocara infection on blood glucose.

Serum bilirubin is a byproduct of bile juice secreted by liver. This blood biochemical parameter acts as an indicator for various types of hepatic infections. In our study, individuals infected with Toxocara infection were found having no significant change in their serum bilirubin level compared to uninfected individuals. Thus indicating that serum bilirubin level does not get altered by Toxocara infection. Our study is supported by Inan et al. (2006), who observed no change in serum bilirubin level in a case of visceral larva migrans, similarly Sommerfelt et al. (2001), observed no
significant change in serum bilirubin in *Toxocara* infected pigs compared to uninfected pigs. The other studies which are in agreement with the present observation are Vidal *et al.* (2003); Xinou *et al.* (2003); Eberhard and Alfano (1998); Inan *et al.* (2006); Singh *et al.* (1992); Sommerfelt *et al.* (2006) and Thakur *et al.* (1998). Thus from the present findings and literature it was concluded that in case of *Toxocara* infection the serum bilirubin level remains in normal range.

Individuals infected with *Toxocara* showed no significant change in their blood urea. The present study results are supported by Inan *et al.* (2006) who in a case of visceral larva migrans observed no change in the level of blood urea by *Toxocara* infection. Similarly Singh *et al.* (1992), observed in a case of visceral larva migrans no significant change in blood urea level by *Toxocara* infection. The other studies which are in agreement with this study are Thakur *et al.* (1998); Vidal *et al.* (2003); Xinou *et al.* (2003) and Ashwath *et al.* (2004). Thus concluding that *Toxocara* infection was not having an effect on blood urea level in humans.

People who were positive for the *Toxocara* infection had higher mean alkaline phosphatase levels compared to uninfected individuals and the difference was statistically significant. These results are in agreement with the Azuma *et al.* (2002) who studied a case of hepatic involvement of visceral larva migrans due to *Toxocara canis* and found that the patient had high level of alkaline phosphatase. So, it can be interpreted from the present study that at the time of screening of patients for *Toxocara* infection, alkaline phosphatase level should also be determined.
5.4. **Toxocara** seroprevalence in hospital patients

The hospital based study was divided into two categories as under:

5.4.1. General patients

In this study only 32.2% of the patients with different diseases were positive for toxocariasis and 68% of patients were negative. This shows that prevalence rate in patients was similar to as that of the general population and that the presence of any disease along with *Toxocara* infection is just a co-occurrence. Similar findings have been observed by Santos *et al.* (2004), who found that intestinal helminthiasis and filariasis have no relation with the presence of *Toxocara* infection. The study thus demonstrates that only presence of the source of infection at any place will determine the presence of disease, if for example in any community dogs are less in number *Toxocara* infection will be less automatically. *Toxocara* infection as is known is caused by dog's roundworm *Toxocara canis* and biliary ascariasis is caused by *Ascaris lumbricoides*, if in any community number of dogs is less and prevalence of Ascariasis is high, naturally, biliary ascariasis will be more. So, it can be said that *Toxocara* leads its life cycle in its own way and any other infection cannot be predicted by the presence of *Toxocara* antibodies or presence of any other type of disease in humans will not be a clue for the presence of *Toxocara* infection in humans. It is also true that in a community where hygiene practices are not followed many diseases can occur simultaneously. This is another reason why number of diseases sometimes persists simultaneously in humans.
5.4.2. Suspected ocular toxocariasis

A definite diagnosis of ocular larva migrans is difficult to establish since the larva is rarely identified from the lesions. Hence, immunodiagnostic tests have been used as a reliable adjunct for the diagnosis of toxocariasis. Among the serological tests enzyme linked immunosorbent assay (ELISA) has been extensively used because of its higher sensitivity and specificity (Benitez et al. 1995). The use of purified ES antigen does not require preabsorption of sera with embryonated Ascaris egg antigen and no cross reaction between purified ES antigen and sera from individuals infected with Ascaris lumbricoides, hookworm, Entamoeba coli or Giardiasis have been observed (Hakim et al. 1992). Testing of vitreous fluid for anti-Toxocara antibodies by ELISA can confirm Toxocara infection when no systemic signs of infection are present and no antibodies are detectable in the serum (Bertelmann et al. 2003). Specific immunotesting on aqueous humor is of particular importance to rule out severe clinical differential diagnosis such as retinoblastoma in children. Antibody detection in Aqueous humor and Vitreous are more reliable than serum for diagnosis of ocular toxocariasis. Treatment with prednisolone and albendazole results in healing of the chorioretinal foci. Well-timed vitrectomy is a suitable therapy for vitreo-retinal complications in ocular toxocariasis to improve prognosis and to confirm the diagnosis (Bertelmann et al. 2003). Ophthalmologist need to be made aware of the ocular toxocariasis-especially in children and young adults and should more often include toxocariasis in differential diagnosis of ocular diseases. Health
promotion by means of a school based programmes of treatment, improving standards of hygiene and control of infection in dogs are necessary for control and prevention of the disease.

In conclusion, the present results indicate that the laboratory testing of clinically suspected toxocariasis using ELISA should be used for mass screening as well as for clinical evaluation of the disease both before and after institution of specific treatment. In addition, aqueous humour whenever available can also be of immense value in detecting anti-

Toxocara

antibody in evaluating intraocular inflammation and visual loss (Bentinez et al. 1995).

5.5. Prevalence of Toxocara canis infection in dog population

The total prevalence of Toxocara canis infection in dogs of the six districts of Kashmir Valley was 19.42% which is in general agreement with other studies conducted in different parts of the world. Coggins (1998) reported 21.4% of prevalence of Toxocara canis infection in dogs of Wisconsin, Humane society (WHS). Kazacos (1978) in Indiana reported 18.3% of examined dogs were infected with Toxocara canis infection, similarly other studies which are in agreement with the present study are Legrottaglai et al. (2003), Rubel et al. (2003), Shimalov (2002), France et al. (1997), Kucharova (1989).

As we know that this parasite is well known by its transmission model, the transplacental migration to the definitive host, the puppy. Prevalence of infection is very high in puppies and decrease with the age of the host. Therefore it is possible that the percentage of Toxocara canis
infection in stray dogs from different areas may vary, depending upon the accuracy of the faecal samples collected from the pups and adults. As Saeki et al. (1997) has reported a prevalence of 79.9% of *Toxocara canis* infection in stray puppies of Ibaraki Prefecture. Similarly Itoh et al. (1997) reported 4.3% of dogs positive for the eggs of *T. canis*. The prevalence of *Toxocara* infection in dog population however varies widely (Table 5.1).

**Table 5.1. Prevalence of *Toxocara canis* in dogs of different parts of the world**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Country</th>
<th>Prevalence (%)</th>
<th>Year</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Venezuela</td>
<td>11.4</td>
<td>2004</td>
<td>Barrios <em>et al.</em></td>
</tr>
<tr>
<td>2</td>
<td>India (Maharashtra)</td>
<td>56.8</td>
<td>1977</td>
<td>Joshi <em>et al.</em></td>
</tr>
<tr>
<td>3</td>
<td>Poland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I) Country dogs</td>
<td>30.95</td>
<td></td>
<td>Ramisz <em>et al.</em></td>
</tr>
<tr>
<td></td>
<td>II) City dogs</td>
<td>22.22</td>
<td>2004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III) Animal Asylums</td>
<td>17.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Argentina (Chubut)</td>
<td>8.8</td>
<td>2003</td>
<td>Thevenet <em>et al.</em></td>
</tr>
<tr>
<td>5</td>
<td>Czech Republic</td>
<td>9.5</td>
<td>2003</td>
<td>Borkovcova</td>
</tr>
<tr>
<td>6</td>
<td>Israel</td>
<td>7</td>
<td>1984</td>
<td>Gross <em>et al.</em></td>
</tr>
<tr>
<td>7</td>
<td>Argentina (Aires)</td>
<td>11</td>
<td>2006</td>
<td>Fontanarrosa</td>
</tr>
<tr>
<td>8</td>
<td>Nova Scotia</td>
<td>26.6</td>
<td>1978</td>
<td>Malloy and Embil</td>
</tr>
<tr>
<td>9</td>
<td>Pakistan (Punjab)</td>
<td>33.33</td>
<td>1998</td>
<td>Maqbool <em>et al.</em></td>
</tr>
</tbody>
</table>

It was found that the prevalence of *Toxocara canis* infection in dogs was almost similar in different districts, exception being district Srinagar where it was only 12.12%. The reason behind this may be the less environmental contamination by *Toxocara* eggs, due to less number of dog...
populations in this district, as Veterinary unit of municipal department has launched a programme of male dog sterilisation in 2004, which in turn decrease the population of dogs in Srinagar. Due to small number of dog population in Srinagar, there is less environmental load of *Toxocara* eggs in soil, thus decreasing the chances of reinfection in dogs and hence overall prevalence of *Toxocara canis* in dogs. The second reason behind it may be safe disposal of the waste substances and the faecal matter of dogs by the municipal department of Srinagar, from the streets, play grounds and parks, making dogs less susceptible to the infection.

To sum up it can be concluded that the presence of the source of infection in vicinity like play grounds, house yards, in schools or in open fields poses a great threat and an easy target of human toxocariasis. Gawor and Borecka (2004), D'souza *et al.* (2002) also consider the highest level of soil contamination as a potential risk of toxocariasis for humans. Similarly according to Sturchelir and Peter (1981) lack of education about personal hygiene is an important factor in determining the prevalence of toxocariasis in humans.
Conclusion

Present study demands an urgent need for initiation of control programs like hygiene conditions in the form of supply of clean piped water, proper fencing of houses, playgrounds and parks. In this study, it was observed that in district Srinagar, *Toxocara* seroprevalence in human was comparatively less. The reasons were many like sterilisation of stray dogs by veterinary unit of municipal department, which decreases dog population, educational level, hygienic conditions etc.

In current study male population was more susceptible to *Toxocara* infection and gender was found as an important risk factor for *Toxocara* infection. The current study revealed a higher seroprevalence of *Toxocara* infection in males relative to females. The difference in the prevalence rate between the genders is due to difference in the gender behaviour. Being mostly indoors, females are relatively less exposed to contaminated environments and have thus lesser chances of getting infection. So, males being outdoors should follow proper hygienic practices not to contract infection.

People sourcing open water bodies like wells, rivers etc for daily uses were found having high rate of seroprevalence compared to others. This indicated that source of drinking water is one of the reasons for the high prevalence of toxocariasis in human along with poor environmental
hygienic conditions leading to a public health hazard, which is threatening the developing countries in general and Kashmir valley in particular.

The habit of working in open fields was found to be a significant risk factor for *Toxocara* infection in humans. Thus proper washing of hands and feet with soap after attending work in fields can decrease the *Toxocara* prevalence in humans.

Persons whose houses were fenced had low rate of *Toxocara* seroprevalence due to less environmental contamination in the vicinity of their residence. Thus stopping the entry of stray dogs in house yards by proper fencing around the houses and checking out the presence of pet in house helps to decrease the rate of *Toxocara* seroprevalence. So, proper attention should be paid towards house fencing and also towards the pets. If pets are present they should be properly dewormed so as to check out the basic source of infection i.e. pet, as the persons having pets in their house had high rate of *Toxocara* seroprevalence.

People eating raw vegetables had high rate of *Toxocara* seroprevalence compared to others, thus demanding our attention towards the role of hygiene in controlling the rate of infection in humans. Raw vegetables if not properly washed before eating lodge some amount of soil, thus acting as a route for *Toxocara* transmission. So, proper washing of vegetables and hands before eating may decline the rate of *Toxocara* seroprevalence in humans.
From the present study it is clear that *Toxocara* infection in humans is involved in decreasing the Hb value and causing eosinophilia and leukocytosis. So, by controlling the toxocariasis infection, these deviations from the normal values can be lowered automatically. Present observations thus should be used by concerned authorities to target vulnerable families and should encourage the involvement of parental education particularly those of mother's in the activities of checking the risk factors in children population, which are more susceptible to infection due to their habit of playing outdoors and less awareness. Long term measures have to be taken by policy makers, planners and responsible authorities, so as to check out the population of dogs and also to launch a deworming campaign against the *Toxocara canis* infection in dogs. Policy makers and planners should also create such an environment in and around the schools, playgrounds, recreational parks etc by developing proper fencing, so as to check out the stray dog entry in these areas and making humans less susceptible to the infection. So, instead of enjoying and making good health by visiting the recreational areas, humans are in turn making themselves victim of *Toxocara* infection by handling the contaminated soil and objects by *Toxocara eggs* in these recreational areas.